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TRANSLATION

SELF-CONTAINED METHODS OF ANTI-RADIATION AND ANTI-CHEMICAL PROTECTION

By

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SELF-CONTAINED METHODS OF ANTI-RADIATION AND ANTI-CHEMICAL PROTECTION

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This translation was made to provide the users with the basic essentials of the original document in the shortest possible time. It has not been edited to refine or improve the grammatical accuracy, syntax or technical terminology.

V. A. Alkhazov and A. P. Tkachev

INDIVIDUAL'NYE SREDSTVA PROTIVORADIATSIONNOY I PROTIVOKHIMICHESKOY ZASHCHITY

Pod Obshchey Redaktsiyey A. I. Burnazyana

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The modern means for inflicting injury on a massive scale include nuclear, chemical and bacteriological weapons. The most powerful of these are the nuclear weapons. Hence, the main efforts should be concentrated on protection against the harmful effects of this type of weapon. Coupled with this, great attention is given in the West to the perfection of chemical and bacteriological armaments. New, extraordinarily toxic poisons (OV) and dangerous bacterial agents have appeared in the arsenal of chemical and bacteriological weapons, which injure the human organism even in infinitesimally small quantities.

Direct contact of radioactive dust, poison gas and bacterial agents with the human organism and body can be prevented by up-to-date and skillful utilization means of antiradiation and antichemical protection. The present brochure is devoted to a description of these means and rules of their utilization, which may serve as a teaching aid in the training of the personnel of the civic defense detachments and the population in general.

I. DEVICES FOR PROTECTION OF THE ORGANS OF RESPIRATION

GENERAL INFORMATION

The basic individual protection device is the gas mask. Originally, during the first World War (1914-1918), the gas mask was invented as a means of protecting the respiration organs of man against toxic agents. Later on, in connection with the development of means for inflicting injury, arose the need for protecting the organs of respiration against other harmful impurities in the air, such as biological pathogenic agents and also radioactive substances, formed during explosions of nuclear ammunition. It was found that gas masks, if suitably improved, can also be successfully used for protection against radioactive substances and bacterial aerosols. Hence, most modern gas masks provide protection of the organs of respiration and sight and also of the cutaneous covering of the head and face of man against the action of toxic and radioactive substances, pathogenic microorganisms and toxins.

Depending on the principle on which the protective effect is based, modern gas masks can be divided into filtering and isolating types.

To the filter masks, belong the gas masks which free the external air from harmful impurities by filtration of the air during its passage through the gas mask cartridge. Isolating gas masks are those whose protective effect is based on complete isolation of the organs of respiration, the face and eyes from the ambient medium. Respiration in the isolating gas mask is achieved by means of an oxygen reserve, lo-

cated in the apparatus itself, and through purification within the device of the exhaled air to remove the carbon dioxide.

The isolating gas mask is in many respects superior to the filter-type mask. It has universal protective properties, i.e. it protects equally well against large concentrations of any harmful substance. Hence, the isolating gas masks (devices) find application in the army as well as in industry. For example, isolating devices and apparatus are used in rescue work in ore and coal mines, during fires, in aviation for high altitude flight, where the atmosphere is greatly rarified, in the carrying out of various kinds of work under water, etc. The isolating gas masks, however, have several important deficiencies, the principal of which are the short duration of action, the relative complexity of the device and its utilization and, also, the great weight and unwieldiness. The filter-type masks have, therefore, found widest application and they are also the basic means of protection of the organs of respiration.

Before we begin to acquaint ourselves with examples of means for protecting the organs of respiration, let us dwell briefly on the principles of the protective effect of these devices and of some of the processes, which take place within the cartridge of the gas mask.

The absorption of vapors and gases in the cartridges of gas masks takes place as a result of processes of adsorption, chemisorption and catalysis and the purification of the air from radioactive dust, germs, toxic smokes and fogs, as a result of filtration.

Adsorption is the term for the phenomenon of retention of the molecules of any substance on the surface of a solid by the action of molecular attraction. This phenomenon has long been known and is widely used in technology. Everyone knows about cases when certain objects give off odors not characteristic of them. This is explained by the ad-

sorption and subsequent emanation by the objects of various odorous substances. For example, clothes, which have been in contact with tobacco smoke for some time, assume the odor typical for tobacco. Adsorption is used in technology for the purification of solutions to remove various impurities.

A solid which adsorbs certain substances on its surface is called an adsorbent. The quantity of adsorbed substance depends on the nature of the surface on which adsorption takes place. The greater the porosity of the surface, as for example in activated carbon, the more readily does the adsorption process take place and the greater is the quantity of adsorbed substance.

The main adsorbent in the technology of antigas protection is activated carbon. For the preparation of activated carbon, various forms of carbon are normally used which are subjected to activation, a special treatment without access of air. As a result of this, the enormous number of pores existing in the carbon are cleared, thus greatly increasing the surface and the carbon assumes the properties of an adsorbent.

Not to be confused with the adsorption process is the process of absorption, in which absorption of the substance takes place throughout the volume of the absorbent. We shall encounter this phenomenon when we study protective filtering clothing.

The phenomenon which is the opposite of adsorption is termed desorption. Activated carbon is capable of adsorbing, under certain conditions, the vapors and gases of any substance. Some substances, however, which are well adsorbed at very low temperatures, are hardly at all adsorbed by carbon under normal conditions. Activated carbon has excellent adsorption properties with respect to the vapors of phosphor-organic poisons, mustard gas, lewisite, nitrogen mustard and chloropi-

crin; fairly well adsorbed are phosgene and diphosgene; poorly adsorbed by carbon are hydrocyanic acid, halogen derivaties of cyanogen and arsine. It was observed that those substances which are most easily liquified, i.e. those having a high boiling point and high molecular weight, are adsorbed most readily.

The processes of chemisorption and catalysis are used for the absorption of substances which are poorly adsorbed on carbon. The process of chemisorption is a chemical interaction between a vapor and a solid or liquid subtance. In this case, the solid or liquid is termed a chemical absorbent (chemisorbent). Activated carbon, on the surface of which chemisorbents have been applied, retains its adsorbent properties almost completely; in addition, the high porosity of the carbon increases the rate of chemisorption.

Catalysis is a process in which an acceleration of a chemical reaction is observed in presence of substances which are termed catalysts. The catalyst is practically not modified during its action, unless it is "poisoned" by other substances which are present during the reaction.

As an example of catalysis, we may mention the oxidation of carbon monoxide by atmospheric oxygen in presence of a catalyst. Under normal temperature conditions, carbon monoxide is chemically stable and is not oxidized in air. In presence of certain solids, however, such as for example manganese dioxide, carbon monoxide is rapidly oxidized by atmospheric oxygen.

Activated carbon with corresponding additions (chemisorbents and catalysts) is used at present as a charge in gas masks, which provides a universal protective effect.

Another process, which takes place in the gas mask - the process of filtration - is of special interest in connection with the fact that it forms the basis of protection of the organs of respiration against

radioactive dust, poisonous smokes and fogs and bacterial weapons.

Radioactive dust, bacterial aerosols, and poisonous smokes and fogs consists of solid or liquid particles of any of the above-mentioned substances, suspended in the air. These particles are thousands of times larger than the molecules of substances present in the form of gases or vapors. In consequence of this fact, the properties of aerosols and gas mixtures differ markedly and the process of absorption of aerosols by fiber materials also differs from the process of absorption of vapors by carbon. During the process of absorption of toxic vapors, the concentration of the toxic agents behind the layer of carbon is zero for some time and then, after the break-through of the toxic agents, gradually increases. A different pattern is observed during filtration of aerosol particles. The concentration of the aerosol behind the filter is not zero, even at the start and practically does not change in the course of time. No matter how perfect the filter material, aerosol particles will penetrate the filter from the very start. The important thing is that the quantity of particles not retained by the filter should not exceed the permissible limits.

In order to evaluate filter materials, filter design and the gas mask cartridge as a whole (with regard to filtering capacity), a measure is used, termed penetration coefficient. The penetration coefficient K is the ratio of the concentration C_1 of the aerosol, after passage through the filter (behind the filter) and the concentration C_0 of the aerosol prior to its passage through the filter (in front of the filter). The penetration coefficient is normally expressed in percent:

$$K = \frac{C_1}{C_0} \cdot 100.$$

It follows that the smaller the penetration coefficient, the better are the protective properties of the filter.

The devices or appliances destined for individual protection against aerosols only are normally termed respirators. It must be kept in mind that sometimes (particularly in the translated literature), the term "respirator" is applied to a larger range of respirator devices. Antiaerosol filters are often termed "antismoke" although, as mentioned above, they protect not only against smoke particles, but also any other aerosol particles.

In the practice of utilization of gas masks and respirators, it was found that an antismoke filter does not equally retain aerosol particles of different dimensions: the fine and coarse particles are well retained, while the particles with medium dimenions (with a radius of about 0.25μ) are less well retained. This property of antismoke filters is termed selectivity.

The mechanism of retention of particles by antismoke filters may be visualized in the form of the following scheme. The fibers of the filter form a dense network; they are loosely arranged with passages between them. During their motion through the filter, the coarse particles impinge on the fibers and are closely attached to them by adhesion forces.

Gas and vapor molecules in the air, being in thermal motion, have high velocities and when colliding with the fine aerosol particles, transmit part of their energy to them. As a result, the fine particles are also thermally agitated, a motion which is of a chaotic nature and is termed Brownian motion. The smaller the particles, the more intense is their thermal motion and the greater the probability of their collision with a fiber and, consequently, their precipitation which takes place upon every collision of this type. Thus, the fine particles are precipitated on the filter due to the Brownian motion. Least efficiently retained by the filter are the particles of medium dimensions: they

are too large to be significantly affected by Brownian motion and insufficiently large to be retained in an airflow by deposition on fibers.

Separate disposition of the absorbent for toxic vapors (activated carbon) and the filter material is now used in gas masks. Various materials capable of retaining aerosol particles, are used as filters. In gas masks and respirators, special filter pads on cellulose basis and filters of synthetic fibers are used for these purposes. The latter find increasing application. Thus, the respirator type "Lepestok" petal has been designed on the basis of superfine fibers of synthetic materials. In the simplest types of protective devices made from improvised materials, the filtering capacity of various fabrics is utilized.

FILTER-TYPE GAS MASKS

Gas masks for the adult population

For the protection of the adult population and the personnel of civilian formations of civic defense, the civilian model GP-4u is used, consisting of the gas mask cartridge and the face part (Fig. 1). The gas mask equipment includes further the gas mask bag and a special "pencil" for preventing fogging of the glass goggles.

The cartridge of the gas mask serves for purification of the inhaled air from toxic and radioactive substances and, also, from pathogenic bacteria and toxins. The air is purified by a special absorbent and antismoke filter, with which the cartridge is charged (Fig. 2).

The civilian gas mask includes the gas mask cartridge type GP-4u, whose housing is made from sheet iron and has a cylindrical shape. Transverse projections and ridges are stamped into the housing, which serve to impart mechanical strength to the housing. At the bottom of the housing, there is a circular orifice, through which the external air enters during inhaling. On the lid of the housing is placed a

screw neck, by means of which the gas mask cartridge is connected with the face part. Inside the cartridge, two perforated (holed) cylinders are soldered on to the lid, a small one and a larger one. Between these is the charge (carbon and catalyst) which frees the air of toxic gases and vapors. On the small perforated cylinder, a conical cap is attached on the bottom and inside the cylinder a pad of antidust paper is placed. The dustabsorbing pad is necessary for freeing the aspirated air passing through the charge from the carbon dust entrained by it.

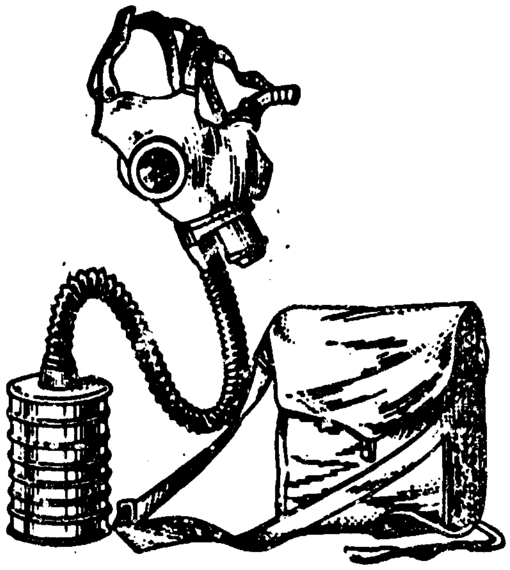

Fig. 1. GP-4u Gas mask.

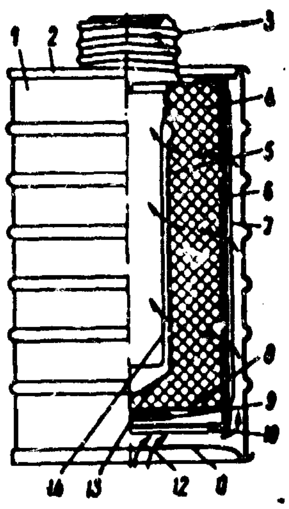

Fig. 2. Schematic view of the design of the cartridge of the GP-4u gas mask. 1) Housing; 2) lid; 3) screw neck; 4) charge; 5) small perforated cylinder; 6) large perforated cylinder; 7) antismoke filter; 8) movable bottom; 9) spring; 10) immovable bottom of the large perforated cylinder; 11) bottom of the cartridge; 12) aperture in the bottom of the cartridge; 13) cap; 14) antidust pad.

The large perforated cylinder has two bottoms, a movable and a fixed one. Between these, there is a spring. Under the action of the spring, the movable bottom exerts pressure on the charge, thus ensuring constant compression of the charge. A corrugated filter is attached to the outside of the large perforated cylinder by means of two iron rings. The filter is made of special filter paper, consisting of a mixture of cellulose and asbestos. The corrugations on the filter are applied for increasing the filter surface and decreasing the resistance to respiration. The antismoke filter is provided for purifying the air of toxic smokes and fogs, radioactive dust and bacterial aerosols.

To protect the metal from rust, the cartridge is painted with grey oil paint on the outside and varnished on the inside. On the outside of the cartridge (on its upper part) between the ridges of the type of cartridge, its date of manufacture, etc., are stamped on.

During storage of the gas mask, the orifice at the bottom of the cartridge is closed by means of a moulded rubber stopper, and the screw neck by means of a special screw cap with rubber or paper lining. This is necessary to prevent spilling of the absorbent for toxic substances and of the antismoke filter.

The face part serves for delivering the air purified in the cartridge to the organs of respiration and also for the protection of the eyes and face against toxic and radioactive substances, microbes and toxins. In addition, it may also weaken the effect of the flashes which accompany nuclear explosions on the skin of the face. In the civic gas mask, the M-49 mask is used as the face part. The face part M-49 consists of a body with goggles, a system of straps with back part and a valve housing and connecting tube.

The body of the M-49 face part is made of rubber in the form of a mask. The goggles are made of glass and attached to the body of the

mask by means of serrated clips. The rubberized back part and the system of straps is provided for attaching the mask to the head. The system of straps consists of two frontal nonstretching and four temporal and two back rubber straps which ensure a good fit of the mask to the face. The tension of the straps can be adjusted by means of clasps attached to them (movable on the frontal and immovable on the back straps).

The valve housing is made of sheet iron and serves to distribute and direct the flow of the aspirated and expired air. The housing is attached to the mask body (at its bottom) by means of a wire and rubberized bank. In the valve housing, there is one valve for inhaling and two for exhaling. The inhaling and the lower (second) exhaling valves consist of a round rubber membrane with an opening in the center, by means of which the valves are attached to pins. The upper expiration valve consists of two round membranes, fastened by four lugs. The lower membrane is continuous, while the upper one (serving as a saddle for the lower one) has an opening in the center with a flange for attachment to the valve housing. The exhaling valve is the most important detail of the valve housing. Inexact function of the exhaling valve or clogging destroys the tight fit and causes contaminated air to be sucked in under the mask during inhaling. Freezing of the valves in very cold weather has the same effect.

In the lower part of the valve housing, there is a removable metallic screen with openings, destined for protecting the lower exhaling valve from mechanical injury and from dropping out.

The valves operate in the following manner (Fig. 3). When the air is aspirated, entering through the connecting hose, the inhaling valve is lifted and the air is admitted under the mask. In consequence of the rarefaction of the air under the mask which takes place during inhaling, the exhaling valves are pressed against their saddles and thus

prevent the access of external air under the mask through the valve housing.

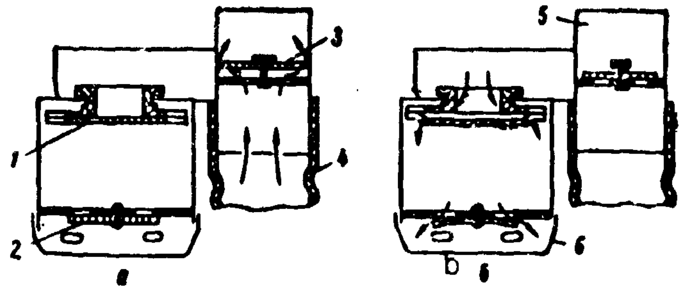

Fig. 3. Working scheme of the valves: a) Aspiration; b) expiration; 1) First, and 2) second exhaling valves; 3) inhaling valve; 4) corrugated tube; 5) shell of the valve housing; 6) screen.

During expiration, an increase in air pressure under the mask is produced. Hence, the inhaling valve is closed, pressed against the saddle and obstructs the flow of the exhaled air into the connecting hose. The membranes of the exhaling valves are lifted from the saddles and the exhaled air escapes to the outside under the mask.

The connecting hose is corrugated and made of rubber and usually covered with fabric, but there are also hoses without such a covering. The upper end of the connecting hose is hermetically attached to the nipple of the valve housing and its lower end is hermetically connected by means of a nipple and sleeve nut with a ring gasket to the screw cap of the gas mask cartridge.

The gas mask as a whole works in the following manner. During inhaling, the contaminated air enters the gas mask cartridge via the orifice on the bottom of the cartridge, goes around the bottom of the large perforated cylinder and then passes through the antismoke filter and the charge, where it is freed of harmful impurities. Passing through the antidust pad of the small perforated cylinder, the purified air enters via the screw neck into the connecting hose and from there via the inhaling valve housing under the mask. The exhaled air goes directly from under the mask to the outside through the exhaling valves.

The gas mask bag is provided for storage and transport of the gas mask. When nuclear weapons are used, the bag also serves as a preliminary filter for freeing the air entering the gas mask of large particles of radioactive dust. The bag has two compartments. In one of these, the gas mask cartridge is placed, in the other, the face part and the special "pencil" used for preventing fogging of the goggles during work with the gas mask. On the bottom of the compartment, where the gas mask cartridge is placed, two wooden strips are attached which facilitate the access of air into the gas mask cartridge when the gas mask is used. The bag is closed by a buttoning-up flap. For convenience, in transporting the gas mask, a shoulder strap is sewn on the bag whose length can be adjusted by means of a movable clasp. The container is attached to the bag during transport of the gas mask in the "alarm" and "combat" positions, by means of a belt strap.

Rules for selecting the mask, verifying its fit and the assembly and packing of the gas mask. The selection of the necessary dimensions of the mask is of decisive importance for the utilization of the gas mask. A face part of larger than necessary dimenions does not give a hermetically tight fit and the contaminated air will enter under the mask and thus also into the respiration organs, thus bypassing the cartridge of the gas mask. This may lead to undesirable consequences. A face part which is smaller than necessary, will strongly compress the head and wearing of the mask will become difficult.

The GP-4u gas masks are made in three sizes (the size of the mask is designated by a number on its chin part). Masks of different sizes differ only in their height. Hence, in order to determine the required size of the mask, the height of the face must be measured. By the height of the face in this case, is meant the distance in a straight line between the deepest point of the bridge of the nose and the lowest

Fig. 4. Measuring the height of the face with a ruler.

Fig. 5. Measuring the height of the face with sliding calipers.

point of the chin. An ordinary student's ruler with millimeter divisions and a flat strip of wood may be used for measuring the height of the face. The measurement must be carried out as shown in Fig. 4. The height of the face can also be determined by means of sliding calipers or sliding calipers made of a ruler with divisions and some pieces of plywood or cardboard (Fig.5). For this purpose, a strip of plywood or cardboard with a beveled round edge is glued perpendicularly to the ruler at the level of the zero division. The second strip should be glued of four pieces of cardboard in the form of a stirrup which slides along the ruler. The measuring end of the sliding strip should have a length of 70 mm and that of the immovable strip a length of 50 mm.

When measuring the height of the face with the ruler, care must be taken to ensure that the zero division of the scale is not displaced relative to the depression in the bridge of the nose; the ruler should be kept in a position exactly parallel to the median line and at a right angle to the auxiliary strip, and the auxiliary strip should not be moved from the lower point of the chin.

By measuring the height of the face by one of the above-described methods, the required size of the mask can be determined, using the following data:

height of face, mm	size of mask
99 - 109	1
109 - 119	2
119 and over	3

Careful adjustment of the selected mask is achieved by corresponding tensioning of the straps. A correctly chosen mask should adhere tightly to the face, thus excluding the possibility of sucking external air in under the mask which bypasses the cartridge without, at the same time, causing discomfort.

Before donning a new mask, it is necessary to rub it on the outside and inside with clean cotton wool (or a cloth) lightly soaked in water and preliminary blowing through the connecting hose. A mask which has been previously used must be wiped with alcohol or 2% aqueous solution of formalin.

When receiving a gas mask, it is first of all necessary to examine it and verify whether all its parts are in working order. The verification of the gas mask is begun with an examination of the face part. The mask is examined to determine whether it has been damaged, the glasses of the goggles, the working order of the straps, their tension and the presence of the sliding clasps. Then the valve housing is examined, verifying the condition of the valves and the presence of the protective screen. The valves should not be torn, warped or clogged. Examining the connecting hose, one should check whether it has any punctures or tears and whether it is tightly attached to the nipple of the valve housing, whether the sleeve nut has bot been dented and whether the rubber lined gasket is present on the nipple.

When verifying the cartridge of the gas mask, attention is paid to the absence of rust, dents, punctures (holes), scratches and also that the screw neck is undamaged and that grains of absorbent have not been spilled in the gas mask cartridge. The stopper which seals the

orifice in the bottom of the cartridge, must be removed before the gas mask can be used.

When examining the gas mask bag, its wholeness and the presence and condition of the button hole on the flap, the button, the belt and shoulder straps, the sliding clasps, the wooden strips in the depressions on the bottom of the bag and the "pencil" against fogging of the goggles are verified. If any damage to the gas mask is discovered, it is mended and, if necessary, the gas mask must be sent for repair and replaced by a serviceable one.

After examination of the gas mask, assembling and fitting of the face part must be carried out. The assembly of the gas mask is carried out in the following manner. The sleeve nut is taken in the left hand (the mask is allowed to hand down freely) and with the right hand, the cartridge is screwed in up to the stop. The fitting of the face part is best carried out in the following sequence. First the frontal straps are extended to their maximum length by moving the clasps, while the temporal and occipital straps are slackened off so that the mask can be easily donned. The mask is then donned, the position of the back part is adjusted by moving the clasps of the frontal straps and the temporal and occipital straps are tightened (without making it too tight).

In order to verify the correct fitting of the mask, the face part must be checked for airtightness. To this end, the connecting hose is folded with the right hand and tightly squeezed under the valve housing and then one inhales deeply. If air then enters under the mask, it means that the fit is insufficiently tight. The occipital straps must be tightened and the test for the airtightness of the face part repeated.

After fitting of the face part, the correctness of the assembly and the correctness of the gas mask as a whole must be tested. For this purpose, it is necessary to don the mask, to take the cartridge from

the bag, to close the orifice in the bottom of the cartridge with a stopper or, if no stopper is available, with the hand and to inhale deeply. If air does not enter under the mask, the gas mask as a whole is in order (air-tight). If, however, air enters under the mask, the gas mask is not airtight. To find the defect, the individual parts of the gas mask must then be examined.

When checking the parts of the gas mask, the cartridge is unscrewed from the connecting hose and the presence of the rubber ring gasket on the nipple in the sleeve nut is checked and also the airtightness of the connection between the upper end of the connecting hose and the valve housing. If any defects are noted, they must be eliminated, the gas mask again assembled and checked. If even upon second verification, air enters under the mask, the following must be done.

First of all, the face mask should be checked. This is done in the same manner as during checking of the mask for airtightness: the connecting hose is bent and tightly compressed with the right hand near to the valve housing and then, one inhales deeply. If the air goes through the mask, it is either faulty or incorrectly fitted. Having eliminated the causes of the faulty operation, depending on the mask and its fitting, the exhaling valve should be blown through and the mask tried again. If air enters in this case, the face part is faulty and must be repaired or replaced by a serviceable one. If the mask proves to be in order (air is not admitted), then the connecting hose is checked. For this purpose, one exhales and bends and compresses the connecting tube at the screw neck of the gas mask cartridge and inhales. If air does not enter, the connecting hose is in order.

The final check of the fit of the mask, the assembly and correctness of the mask as a whole is carried out in a confined space (tent) with an irritating gas. Chloropicrin is normally used for this purpose.

The checking of gas masks in a room containing chloropicrin may be carried out only under observation by experienced instructors and in presence of a medical worker. Only persons who have studied the properties of the poison gas, the gas mask and its use and also the special sequence of checks in the room filled with the poison gas, are permitted to test gas masks in an atmosphere charged with chloropicrin vapor.

The tested gas mask is then placed in the bag in the assembled form. The cartridge is placed into the small compartment of the bag and the face part in the larger one. Before placing the face part in the bag, one must take the mask by the valve housing with the left hand in such a manner that the goggles are away from the person and with the right hand, the back part and straps are placed inside the face part. The large compartment of the bag is then kept open and first the connecting hose and then the mask with the valve housing on the underside (it is not recommended to fold the mask) are placed in it.

During prolonged work in the gas mask, the glasses of the goggles are fogged. This is due to condensation of water vapor upon contact of the expired air saturated with the vapor with the colder surface of the glasses. The fogging of the goggles of the gas mask will be the more severe, the lower the temperature of the ambient air. To prevent the glasses of the goggles from fogging, a special "pencil" is used. The "pencil" is a stick made of a soap-like composition and is kept in a plastic case. To protect the glasses of the goggles against fogging, they are wiped with a clean cloth and the pencil is applied to the internal side of each glass, five to six strokes being made in the form of a net. Then, one breathes on the glass and rubs the paste in a uniform transparent layer over the entire glass surface by a rotary motion. If such a "pencil" is not available, ordinary soap may be used in the same manner. After each use of the gas mask, the greasy glasses must

be carefully wiped clean.

Rules of utilization of the gas mask. The reliability of protection of humans against toxic and radioactive substances and pathogenic microbes and toxins depends not only on the working order of the gas mask but also on its skilful use. It is, therefore, necessary to learn in advance to don the gas mask quickly and correctly.

The gas mask is carried in three different positions - in the "marching," "alarm" and "combat" position (Fig. 6). In the "marching" position (in absence of direct danger of chemical or bacteriological attack or radioactive contamination), the gas mask is carried in the bag on the left side, with the valve away from the person (Fig. 6,a). During walking, the bag with the gas mask can be moved backward, in order to prevent it from interfering with the movement of the arms.

In the "alarm" position (if there is a threat of chemical, bacteriological or nuclear attack) the gas mask is attached on the left side of the body by means of the belt strap (cord) (Fig. 6,b) or on the chest (if a gas mask is used which has a face part with a short connecting hose). The flap of the bag is ready to be opened quickly. The gas mask is transferred to the "alarm" position upon the command "Gas masks ready," or on the wearer's own initiative.

The gas mask is carried in the "combat" position under conditions of immediate chemical, bacteriological or radiation danger. The transfer of the gas mask from the "alarm" position to the "combat" position is carried out upon the command "gas," if the signal "chemical attack," or "radioactive contamination" is given, or independently (Fig. 6,c).

The following is necessary for donning the gas mask: the breath must be held and the eyes closed, the headgear removed and placed nearby or held between the knees; the mask is taken from the bag, the occipital and temporal straps gripped with both hands in such a way that

the thumbs are inside the mask and laying the lower part of the mask against the chin, it is drawn over the face bringing the occipital straps behind the ears (the back part should be in the center of the back of the head). Having donned the mask, the wearer exhales sharply and deeply, opens the eyes, resumes breathing, dons his headgear and closes the flap of the bag. The gas mask has been donned correctly if the goggles are aligned with the eyes, the straps are not twisted and the mask adhered tightly to the face.

When donning the mask, special attention must be paid to holding the breath and closing the eyes. This must be done because new highly toxic poisons have appeared, which can cause serious injury to people even in small concentrations. This also explains the need for exhaling strongly before closing the eyes after having donned the gas mask. The purpose of this procedure is to remove the contaminated air from inside the mask, which could have collected there during the donning of the gas mask.

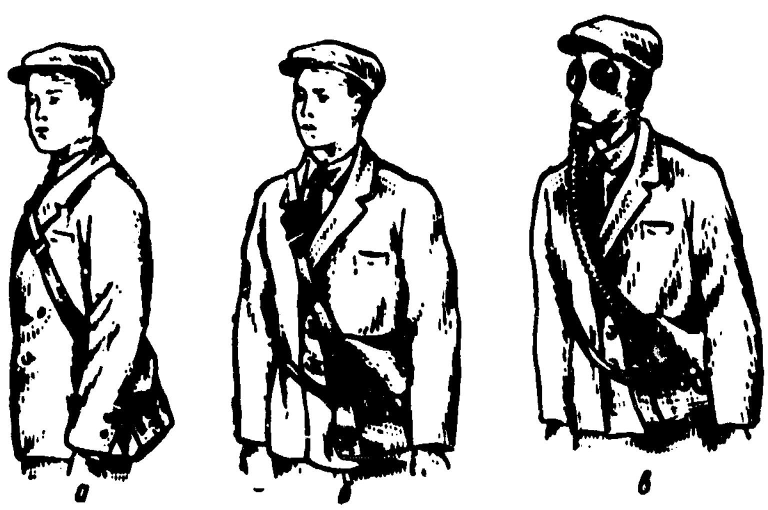

Fig. 6. Position of the gas mask; a) "Marching"; b) "alarm"; c) "combat."

The gas mask may not be taken off until the signal "end of chemical attack" is given, or upon the command "take off gas masks." The gas

mask may be taken off upon the wearer's own initiative (without command) only in the event that it is reliably known that the immediate danger of injury has passed. To remove the gas mask, the headgear must be taken off with the right hand, the valve housing gripped with the left hand, exerting a light downward pull on the mask and with a forward and upward movement of the hand, take off the mask and don the headgear. Once the mask is taken off, it must be unscrewed, carefully wiped with a clean cloth (or dried) and placed in the bag. The gas mask, depending on circumstances, is then either transferred to the "alarm" position, or the "marching" position.

When using a gas mask in the winter, it is possible that the rubber becomes hard, that the glasses of the goggles are frosted, that the flaps of the exhaling valve are frozen or frozen to the valve housing, or that moisture which has entered the connecting hose is frozen and that the hose is clogged. All this impedes the use of the gas mask and can lead to failure in operation. To prevent and eliminate the above enumerated faults, the face part, when the wearer is in an uncontaminated atmosphere, must be periodically warmed up by placing the mask inside the lapel of the overcoat or fur coat. If the mask is frozen before donning it, it must be slightly kneaded and after having been put over the face, warmed with the hands until it fits tightly against the face. During donning of the gas mask, freezing of the exhaling valves must be prevented by warming the valve housing from time to time with the hands and, at the same time, blowing through the exhaling valves.

After use of the gas mask, clumps of ice which may have formed there, must be removed from the connecting hose. When entering a warm place from the frost, the gas mask cartridge and other metal parts must be allowed to warm up for 10-15 minutes after which the mask and the metallic parts are carefully wiped with a dry cloth.

During the use of the gas mask, individual parts of it can be damaged in some way. Naturally, it is not always possible to replace a faulty gas mask rapidly and the damaged gas mask must be used a little longer. It must, therefore, be well remembered what kinds of damage permit continued use and what measures must be taken.

If the edge of the mask is slightly torn or one of the straps has been torn off, the mask must be tightly pressed against the face with the hand at the point of damage, or where the strap is missing. If the face part has been considerably damaged (large tear, holes in the mask or in the connecting hose, damage to the glass of the goggles or the upper exhaling valve), the following measures must be quickly adopted: the breath must be held, the eyes closed, the mask grasped and, taking out the cartridge from the bag, the cartridge must be unscrewed from the connecting hose, the screw neck of the cartridge taken into the mouth, the nose held and, not opening the eyes, breathing must be continued with the mouth only through the cartridge.

If a puncture (hole) is detected in the gas mask cartridge, it must be stopped up with clay, earth, bread crumbs, etc. At the first opportunity, the damaged cartridge should be replaced by a good one. For this purpose, the mask which is in working order, must be made ready for rapid donning: the flap of the gas mask bag is unfastened, the face part taken out and a check made to determine whether the rubber stopper has been removed from the bottom of the cartridge. If not, it is taken out. The headgear is then taken off, the breath held, the eyes closed and the face part of the damaged gas mask taken off. The face part of the intact gas mask is then quickly donned, the breath exhaled, the eyes opened and respiration resumed. The cartridge on the intact gas mask must be placed in its bag and the damaged gas mask placed in the bag from which the new mask had been taken.

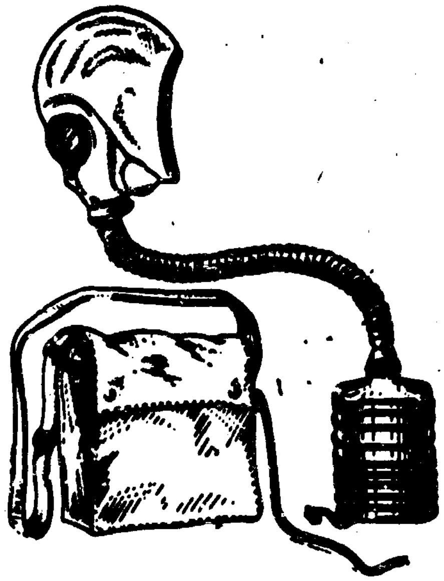

Fig. 7. Military gas mask.

In some cases, the civilian population can use filter gas masks of the military type for protecting the organs of respiration. Hence, we must dwell on the description of the design of these gas masks.

Like the civilian GP-4u gas mask, the military model also provides protection of the organs of respiration, the face and eyes against the effects of poison gas, biologically morbific agents and contamination by radioactive dust. The general design principle of the filter gas masks of military type is analogous to the design principle of the GP-4u gas mask. The design of individual parts of these gas masks, however, may differ considerably.

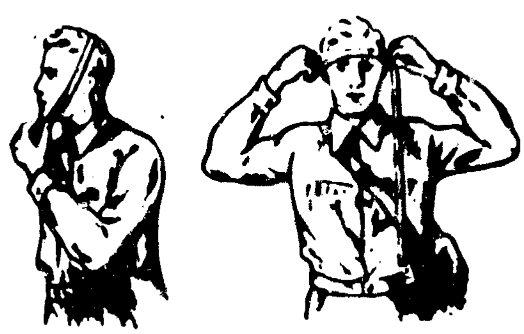

Fig. 8. Measurement of the head for selecting the size of the helmet gas mask.

The complete military filter gas mask consists of the following

components: antigas cartridge, face part, gas mask bag, non-fogging films or a "pencil" for preventing fogging of the goggles. The winter gas mask may contain additionally, sleeves for heating the goggles. A general view of the gas mask is shown in Fig. 7.

The antigas cartridge of the general military model has an oval or cylindrical shape. The face part of the gas mask is made in the form of a helmet mask and covers almost the entire head. The helmet mask is connected with the antigas cartridge by a corrugated hose. The helmet masks have five and three dimensions depending on the face part. The size is indicated by a figure on the chin part of the helmet mask.

In order to determine the required size of the helmet mask, two head measurements must be carried out: the first - in a closed line going from the top of the head along the cheeks to the chin and back to the top of the head (Fig. 8,a), the second - along a line connecting the openings of the ears and passing along the forehead across the eyebrow arches (Fig. 8,b). The sum of the results of these two measurements determines the size of the helmet mask, using the following data:

Sum of measurements, cm	Size of helmet mask: size design	Size of helmet mask: three size design
Up to 92	0	1
92 - 95.5	1	2
99.5 - 99	2	
99 - 102.5	3	3
over 102.5	4	

The gas mask bag of the military model also differs somewhat from the bag of the GP-4u gas mask. It has three departments: one for the antigas cartridge, one for the face part of the mask, the non-fogging films and "pencil" against fogging of the goggles and a third one for a protective cover. Besides, there may be an external pocket on the bag for an individual antigas package.

The rules for using the military model gas mask are the same as those for the civilian gas masks.

Children's gas masks

Special means of individual protection have been devised for children:

1) Children's gas masks DP-6 and DP-6m, for protecting the organs of respiration, the face and eyes of children of from 18 months to 14 years of age;

2) KZD-1 protecting boxes for children for the protection of children of up to 18 months.

The DP-6 and DP-6m gas masks and the KZD-1 protective boxes provide protection against poison gas, biological pathogenic agents and radioactive dust. The design of children's gas masks is analogous to that of the civilian gas mask GP-4u and consists of the antigas cartridge, the face part MD-1, the bag and the "pencil" against fogging of the goggles.

The DP-6m gas masks (Fig. 9) are destined for young children (up to 12 years of age) and are complemented by the face parts type MD-1 of only the first four sizes and lightened cartridges D-11. The antigas cartridges D-11 are similar in their design to the cartridges GP-4u and differ only in their dimensions.

The DP-6 gas masks are destined for older children and are completed by the face parts of size 5 and the GP-4u cartridges. The bags of the gas masks DP-6 and DP-6m differ only in their dimensions.

The MD-1 mask is made of elastic rubber and has glass goggles in a metallic clip, a rubber valve housing, connecting hose and a back part with a system of straps. The inhaling and exhaling valves are separately placed in the face part. The inhaling valve is attached to the saddle nipple, to which the connecting hose is attached. Two exhaling

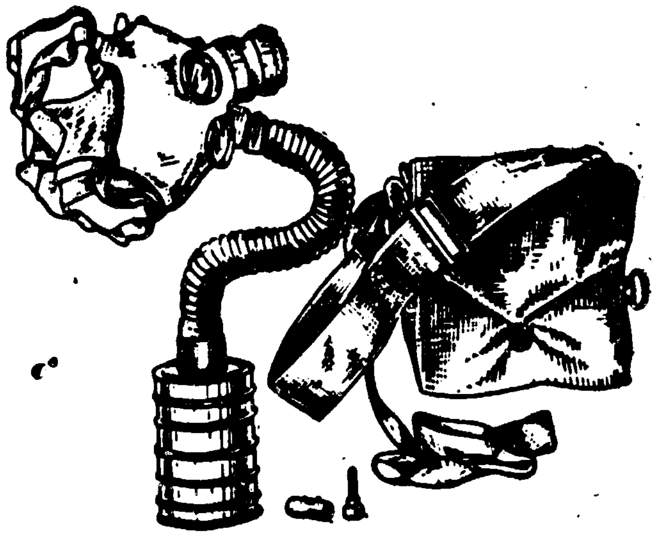

Fig. 9. Children's gas mask DP-6m.

valves are attached to plastic saddles mounted in the valve housing in such a manner that a small chamber is formed between them. Outside, on the lower part of the valve housing, there is a metallic screen for protecting the valves against mechanical damage. The connecting hose is hermetically attached to the mask: in masks of size 1, on the side of the valve housing and in masks of the other sizes above the valve housing.

The mask is attached to the head by means of the back part and the system of straps with metallic clasps. The masks of the first three dimensions also have so-called safety straps, which do not permit the child to take the mask off without the help of an adult.

In order to determine the necessary size of the mask, two measurements must be carried out on the face of the child. First, the height of the face must be measured in the same manner as is done when determining the size of the face part M-49 of the civilian gas mask GP-4u. Then, the width of the face must be measured, i.e. the distance between the most prominent points of the yoke-bones (Fig. 10). The measurement may be carried out with homemade or standard sliding calipers, whose jaws, however, should have a length of 9 cm. The size of the mask is

determined on the basis of the following data:

height of face, mm	width of face, mm	size of mask
up to 77	up to 108	1
77-85	108-116	2
85-92	111-119	3
92-99	115-123	4
	124-135	5

If the measurement results do not agree with the above figures, the required size is determined by careful fitting of the mask directly on the face of the child. In the absence of sliding calipers, the masks can be approximately determined by measurements of the height of the face, only by means of a student's ruler. The size of the mask in this case is, of course, determined only on the basis of the height of the face.

Fig. 10. Measurement of the width of a child's face

Having determined the size and selected the required mask, it must be carefully adjusted on the face of the child. The selection and fitting of the mask for children of preschool age and junior school age should be carried out by adults. Older children can select and fit the mask themselves. A correctly chosen mask should lie tightly against the face with its edges. The goggles of the mask should be in front of the child's eyes. The permissible deviation relative to the center of the eye is not more than 1/3 of the diameter of the goggles.

As previously remarked, the reliability of protection depends not merely on the working order and good fit, but also on the correct and rapid donning of the gas mask. The parents and educators, therefore, must learn the rapid and correct donning of gas masks to children of pre-school and junior school age.

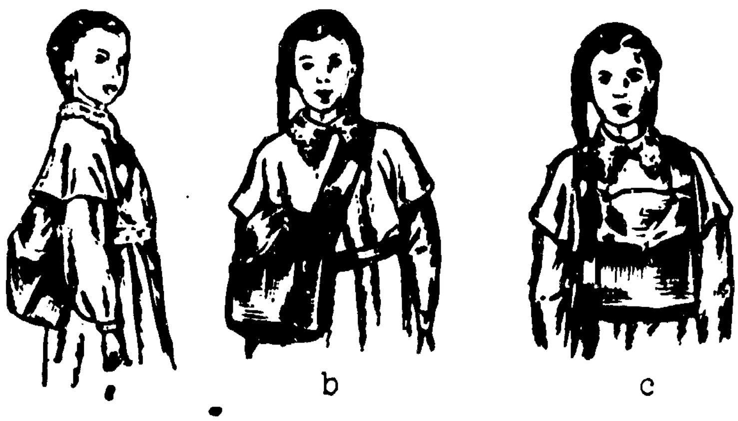

Fig. 11. Position of the children's gas mask. a) "Marching"; b) "alarm" when worn on the side; c) "alarm" when worn on the chest.

The rules of usage of children's gas masks differ little from the previously discussed rules of utilization of the GP-4u gas mask. There are some peculiarities in the use of children's gas masks, however, on which we must dwell briefly.

Children's gas masks are also worn in three positions: "marching," "alarm" and "combat." However, in the "marching position," the gas masks DP-6m and DP-6, in contrast to the other models of filtering gas masks, are worn on the right side (Fig. 11,a) which is due to the design peculiarities of the mask MD-1 of the first dimension. This requirement must be observed. In the "alarm" position, the children's gas masks may be worn on the side as well as on the chest (Fig. 11, b and c). The gas mask is placed on the chest if the length of the connecting hose is insufficient.

The KZD-1 protective box for babies (Fig. 12) consists of a col-

Fig. 12. KZD-1 protective box
for babies.

lapsible wooden frame, an envelope of special design made of rubberized fabric, the antigas cartridge GP-4u, connecting hose, bellows and belts. The envelope of the box has a window which makes it possible to observe the behavior of the baby in the box, a flexible glove, a seal for making the box airtight and inlet and outlet valves. The envelope which is slipped over the frame, forms a box with a volume of 50 liters, inside of which the child is placed. The connecting hose is connected with one end to the nipple with the inlet valve on the envelope of the box and with the other to the screw neck of the antigas cartridge. The antigas cartridge is connected with the bellows by means of a rubber sleeve and little straps.

Airtightness of the protective box is achieved by means of an airtight seal. The purified air is admitted to the box with the aid of the bellows (operated by the mother or other person in charge of the child). The box with the child is carried on the left arm. The bellows are placed on the right side and the air is pumped with the right elbow.

For providing normal conditions of stay for the child in the box, the bellows must be worked 10-15 times every 15-20 minutes, approximately in the rhythm of the person's own breathing.

Effect of the antigas on the human organism

It is known that staying in the gas mask even in the resting state involves a certain inconvenience. This is due to the fact that when a gas mask is used, additional strains are placed on a person, connected with the specific effects of the gas mask on the organism. To these specific effects, belong the resistance to respiration, the dead space and the pressure of the face part of the mask on the head.

When wearing a gas mask, a person always experiences a certain difficulty in breathing which becomes particularly noticeable when physical work is performed. This is due to the fact that during inhaling or exhaling, the air encounters various obstacles on its path (the slots in the valves, the corrugated hose, the charge, filter, etc.), which offer resistance to the airflow. This resistance to the airflow during its passage through the gas mask is termed respiration resistance. The greatest proportion of the respiration resistance is due to the antigas cartridge, because the current of inhaled air must overcome particularly great resistance during its passage between the fibers of the antismoke filter and the adsorbent grains.

As previously pointed out, respiration resistance during the use of the gas mask is not constant. It depends to a considerable degree on the rate, at which the air flows through the gas mask. Resistance increases with increase in the speed of the air flow. This means that a person in the resting state, when wearing a gas mask, experiences less difficulty in breathing than when carrying out physical work, when the oxygen requirement is greatly increased.

The dependence of the requirement for air on the work which is performed, is evident from the following data:

	Quantity of air required, l/min
Resting state	8-10
Walking at a speed of 4 km/hr	25-30
Running at a speed of 12 km/hr	60-65

The dead space in the gas mask is the volume of all recesses in the gas mask, where the exhaled air, containing a greater quantity of carbon dioxide and moisture is retained. During the next inhaling, this air is mixed with the air freed of chemical agents and aerosols, which passes through the antigas cartridge and enters the lungs.

The effect of the respiration resistance and the dead space is reflected in a certain disturbance of the vital activity of the organism. In persons not trained in the use of gas masks, working capacity may be lowered, respiration disturbed (sometimes so markedly that the mask may have to be taken off).

The face part of the gas mask may exert pressure on the face and head, limit the field of vision and lower the acuity of hearing when helmets are used. As a result of the pressure on the temples and forehead, headache may appear. The limitation of the field of vision and the lowered acuity of hearing can adversely affect the accuracy and reliability of movements. All this together lowers the working capacity.

The harmful influence of the above-mentioned factors and the difficulty of working in the gas mask may be considerably lessened by correct selection of the dimension of the face part and systematic training in prolonged activity while wearing the gas mask. Of greatest importance, is antigas training whose purpose is to develop an adaptation to the gas mask through habit. Once habituated in this way, a person can work in the gas mask as quickly and reliably as without it. It is very important that persons undergoing training should be given physical loads corresponding to their work under real conditions. When gas mask training is carried out, the necessary safety measures must be strictly observed, the load must be greadually increased and careful medical control must be exercised.

ISOLATING DEVICES AND APPARATUS

Isolating devices and apparatus are of different types and differ from each other by a number of characteristics which form the basis of their classification. Depending on their purpose, the isolating devices and apparatus may be divided into land, underwater, amphibious and altitude types.

According to the principle by which the oxygen for breathing is provided, the isolating devices and apparatus are divided into two groups: a) devices with compressed oxygen; b) devices with chemically combined oxygen.

In the devices (apparatus) of the first type, the store of oxygen is contained in the compressed condition in metal cylinders, from where it is supplied for breathing by a special mechanism. In the devices of the second type, oxygen is liberated as a result of a chemical reaction from substances containing it in large quantities.

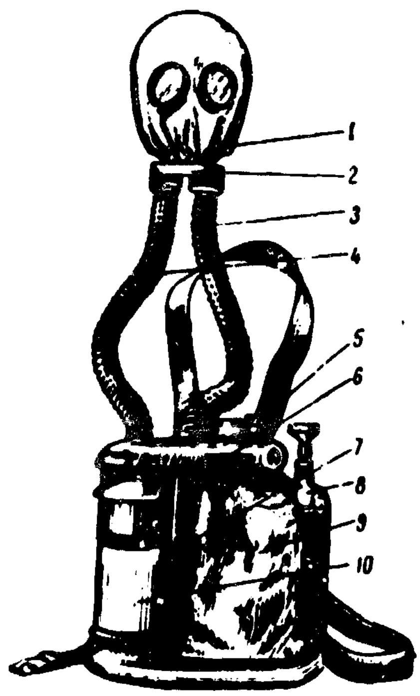

Fig. 13. Oxygen isolating device KIP-5 (housing open). 1) Helmet mask; 2) valve housing; 3) corrugated hose for inhaling; 4) corrugated hose for exhaling; 5) mechanism for constant oxygen feed; 6) housing of the apparatus; 7) excess pressure relief valve; 8) oxygen cylinder; 9) airbag; 10) regenerating cartridge.

Let us examine the design of the oxygen isolating device KIP-5 (Fig. 13) which is widely used at present. The KIP-5 belongs to the devices of the first type with regard to the principle of supplying oxygen (i.e. it works on compressed oxygen). It is destined for use in special units of the nonmilitary formations of civic defense.

The oxygen isolating device KIP-5 provides protection of the organs of respiration and sight of man against all harmful impurities at any concentration. KIP-5 may also be used for staying and working in an atmosphere containing quantities of oxygen insufficient for human respiration.

The device belongs to the category of regenerative devices. This means that the exhaled air is not removed from the device to the outside, but is freed of carbon dioxide and enriched with oxygen in the device itself and again supplied for breathing. The duration of work with this device with a single oxygen cylinder is 40-60 minutes and if the cylinder is replaced during working, for 1.5-2 hours. KIP-5 weighs about 9 kg.

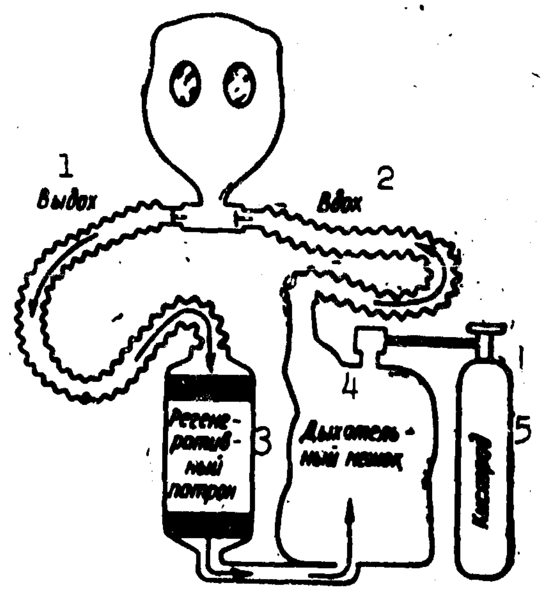

Fig. 14. Schematic diagram of human respiration in the device KIP-5. 1) Exhaling; 2) inhaling; 3) regenerative cartridge; 4) breathing bag; 5) oxygen.

The breathing of a person in the device KIP-5 is schematically shown in Fig. 14. The exhaled air with lowered oxygen content and containing 4-5.5% of carbon dioxide passes through the exhaling valve and reaches via the exhaling hose, the regenerating cartridge filled with lime absorbent in a quantity which makes two hours work in the device possible.

The exhaled air, passing through a layer of absorbent, is freed of the carbon dioxide and passes through the lower connecting tube into the breathing bag. Oxygen from the cylinder is here added until the oxygen content is normal. The oxygen-enriched air then enters the helmet mask via the inhaling hose and the inhaling valve and then the human respiration organs.

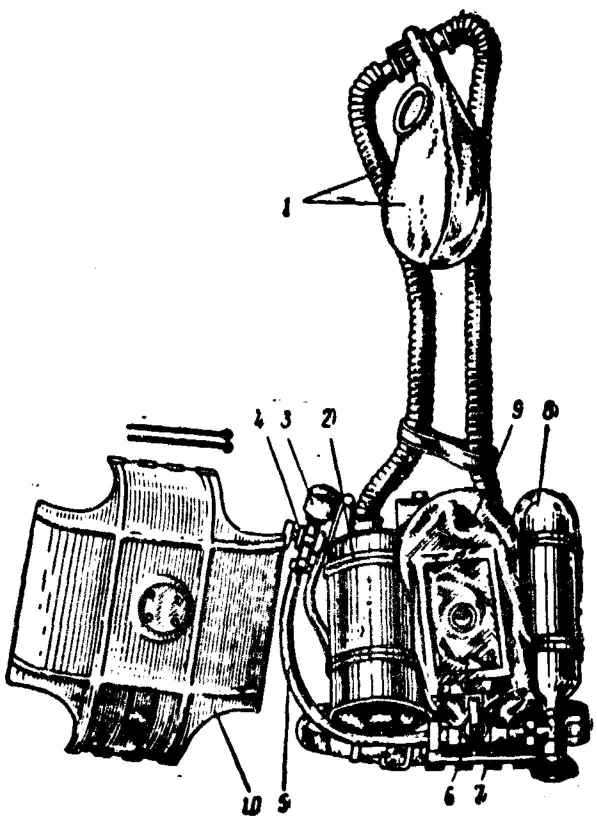

Fig. 15. IPSA apparatus: 1) Face part with the inhaling and exhaling corrugated hoses; 2) absorbent cartridge; 3) oxygen reserve indicator; 4) minimum pressure indicator; 5) high-pressure hose; 6) automatic lung; 7) housing; 8) oxygen cylinder; 9) breathing bag; 10) cover.

As isolating antigas devices of other types, used in the nonmili-

tary formations of civic defense, we may mentioned the apparatus of type IPSA (isolating underwater-dry land apparatus) (Fig. 15) and IP-46.

In the "marching" position, the IPSA apparatus weighs 14.5 kg. (together with tool bag and life belt), and in the "combat" position 11 kg. If an individual performs heavy work on land, the apparatus can be used for 1.5 hours, at a medium physical load, for 2-3 hours and when used in the resting state, up to 4 hours and underwater not more than 1.5 hours (at a depth of 20 m not more than 20 minutes). The life belt is used for underwater work; it serves as an additional aid for floating up to the surface and can also be used for swimming on the surface.

A combined diving-dry land helmet is used as the face part of the IPSA apparatus. The mouthpiece and nose clamp which are included, are used only for underwater work. On the inside of the helmet there is a glued-in rubber seal for providing the necessary airtight fit of the helmet to the head.

The helmet is made in four sizes (marked on the occipital part of the helmet). The required dimension of the helmet is determined on the basis of the results of head measurements (a closed line passing across the top of the head, the chin and cheeks):

Data of head measurement, cm	Size of the helmet
60.5-63.5	1
63.5-66.5	2
66.5-68.5	3
68.5-71.0	4

The scheme of the motion of the exhaled air, its purification by removal of the carbon dioxide, the enrichment with oxygen and the return flow of the air under the helmet during inhaling in the IPSA apparatus differs little from the breathing scheme in the device KIP-5.

The isolating gas mask IP-46 is destined for protection under the same conditions as IPSA.

Only persons well acquainted with the design and rules of handling them, are permitted to use isolating devices. As a rule, the description and instruction for the use of isolating devices are included with each device (apparatus). Special attention should be paid to the safety measures during water work with isolating devices.

RESPIRATORS

In addition to the filtering and isolating gas masks, which have universal protective properties, antidust respirators of various types may be used for protecting the organs of respiration from radioactive dust.

The antidust respirator is a device intended for individual protection of the organs of respiration against harmful aerosols, based on the principle of filtration of the inhaled air. Respirators have found wide application as protective devices in work involving dust development.

Fig. 16a. Respirator in the working position.

Respirators usually consist of a face part (mask or half mask) on

which filter elements are mounted (Fig. 16,a and b). In some respirator designs, it is possible to replace the spent filters by new ones. In some types of respirators, the material of the face part itself has filtering properties. In these respirators, the face part itself is the filtering element. There are also respirator designs with inhaling and exhaling valves and without them. Carrying out different kinds of work for prolonged periods with the respirator does not cause any special inconvenience, because it offers relatively little resistance to respiration and has low weight.

Fig. 16b. Respirator
ShB-1 "lepestok" (petal)
in the working position.

The simplicity and ease of application, the light weight and small size, the low cost and the possibility of mass-producing them, all this in combination with a fairly high protective efficiency against aerosols, makes respirators very important in peacetime (protection against harmful industrial aerosols) as well (and particularly so) in wartime.

Our industry turns out respirators of several types: ShB-1 "Lepestok," RPP-57, PRB-5, R-46, ShB-2 and others. When using a respirator for protection against radioactive dust, it must be kept in mind that some of them, for example R-46, are produced with filters as well as

with absorbing (antigas) cartridges. Respirators equipped with absorbing cartridges are destined for protection against different industrial gases at low concentrations. Before such respirators can be used for protection against radioactive dust, the absorbing cartridges must be replaced by filters.

In industry and laboratory practice in recent years, the valveless antidust respirator ShB-1, which is known also under the name "Lepestok" (Fig. 16,b) has found wide application. This is a very simple design of a device for protecting the organs of respiration against dust. It is entirely made of a special material with high filtering capacity. It weighs about 10 g. This device is very suitable for protection of the organs of respiration against harmful aerosols, including radioactive dust.

The respirator ShB-1 consists of five interconnected parts: the housing, a rubber band, an aluminum plate, a plastic spacer and two straps. Because the respirator ShB-1 differs in design from the usual respirators, we shall dwell briefly on the rules of its utilization.

Before using the respirator ShB-1, the following is necessary: it must be taken from the package, the ends of the rubber bank must be pulled out to the required length, strongly tied in a straight knot, the excess rubber cut off and the remaining ends and the knot put under the border. The edges of the respirator are uniformly adjusted along the rubber band. The respirator is then put on, beginning with the chin, then by stretching the rubber band, the upper edge is placed on the bridge of the nose, the aluminum spacer is squeezed to conform to the shape of the nose, after which the straps are lightly tied at the back of the head without stretching them; by a light pressure of the fingers, the edges of the respirator are adjusted so that they adhere tightly to the face.

The respirator must not be touched with the hands or other objects during use.

Respirators normally do not provide any eye protection. The most different types of goggles with colorless glasses, whose design is such that dust cannot get into the eyes, can be used for this purpose: protective goggles No.5 (so-called flying or driver's goggles); No. 1396 1/2; PO-1 airtight goggles; SKh-54/57 (rimless goggles, foldable) and also sporting type protective goggles with rubber rim, etc.

The so-called industrial gas masks may also be used for protection against radioactive dust. All industrial gas masks, turned out by our industry, can be divided into two types: a) antigas masks, charged only with an absorbent for gases and vapors of toxic substances, evolved during industrial processes and b) gas masks equipped with an absorbent for gases and vapors and also a filter against toxic smokes and fogs.

To the first type belong the gas masks BK. The color of the cartridges of these gas masks depends on the substance against which they are intended to protect. Thus, for example, the cartridge for freeing the air of ammonia vapors is painted green and that for sulfur dioxide, blue. To the second type, belong the gas masks BKF. It is quite obvious that these gas masks must be used for protection against radioactive dust. They are easily distinguished from the gas masks BK, because there is a white vertical bank on the BKF cartridges.

SIMPLEST PROTECTIVE DEVICES

The simplest devices for protection of the organs of respiration and the eyes against radioactive dust, are the antidust fabric mask (PTM-1), cottonwool-gauze and other bandages.

The antidust fabric mask (Fig. 17) is very simple in design and can be made in each family. It is sewn from textile materials. The purification of radioactive dust-containing air is achieved by the entire

Fig. 17. Antidust fabric mask PTM-1.

surface of the mask upon passage of the air through it during inhaling (as in the respirator ShB-1 "Lepestok" and ShB-2). The mask has two principal parts: the housing and the attachment. The housing of the mask consists of four or five layers of tissue. The part of the housing over the eyes is cut out and glasses with dimensions of 5.5 × 4.5 cm are inserted into them. The rim of the housing has an edge made of a strip of fabric.

The attachment of the mask to the head is achieved by means of a bank of fabric sewn on to the short sides and the lateral rim of the mask housing. The upper and lower edge of this brace is hemmed in. Into the seam of the upper edge, a rubber band having a width of 0.8-1.5 cm is inserted for a length of 19 to 22 cm, depending on the dimensions of the mask and into the seam of the lower edge, two strings, whose ends protrude from the cut on the lower edge to the outside. Two pieces of strap or band with a length of 45 cm each, are used for the strings. The ends of the rubber bands and strings are sewn together with the brace to the housing of the mask.

The tight fit of the mask to the head is achieved by means of the strings and rubber bank, sewn to the ends at the upper corners of the mask housing. The width of this bank should be 1-3 cm and the length

40 cm.

The instructions on the sewing of the mask also contain cut-out patterns for all its parts corresponding to the four mask sizes. The size of the mask depends on the height of the face:

Height of face, mm	Size of mask
99-109	1
109-119	2
119-129	3
129 and over	4

For sewing masks PTM-1, new fabrics can be used as well as pieces of fabric from worn items of clothing. In the latter case, the individual parts of the mask should be made from pieces of tissue, which are least worn. A severely worn or dirty fabric is not suitable for sewing masks.

The following fabrics are suitable for making masks: for the outside layer - coarse calico, staple fabric or knitted fabric, madapollam-calico, tartan, etc. for the inner layers - children's pique, cotton cloth, woolen blankets, fustian, cotton or woolen fabrics napped on one or both sides, etc.; for the innermost layer - fabrics which do not produce stains on the skin when wet.

The finished mask must be carefully examined and measured. A mask which has been correctly made and sewn to size should tightly adhere with its edges to the surface of the forehead, temples, cheek bones and chin with a width of not less than 2-3 cm and the glasses of the goggles should be in front of the eyes.

The mask is donned in the following manner: the headgear is taken off, the mask is taken with both hands at the lower edge of the attachment in such a manner that the thumbs are turned inwards. The lower part of the mask is laid against the chin and the attachment is put

around the head (the rubber band attachment should be a little lower than the center of the back of the head). The mask is then tightly pressed against the face, the attachment on the head adjusted with the hands and the ends of the occipital bands are stretched and knotted. The mask is arranged in the most convenient position on the face and the headgear put back. Before the mask is put on, the inner surface of the glasses should be covered with a soap film by means of the "pencil" in the previously described manner, in order to prevent fogging.

When using the PTM-1 during wintertime, the frontal part of the mask may become entirely wet or covered with ice and moisture may also freeze on the goggles. To prevent or eliminate these phenomena, the mask must be warmed with the hands in the gloves without being taken off.

If the mask is used for long periods in contaminated territory, dangerous quantities of radioactive dust may accumulate in it. Such a mask must be subjected to special treatment when leaving the area of radioactive contamination. After the mask has been taken off, it is beaten out with the necessary caution and washed with soap in hot water, changing the water several times when rinsing it. The mask must be stored in specially made boxes or packets.

The design of the cottonwool-gauze and other bandages and the methods of making as well as the rules of using them are relatively simple and have been sufficiently described in the various literature, that we need not discuss them here.

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When using respirators, industrial gas masks and the simplest means of protection, it must always be remembered that they protect the organs of respiration only against contact with radioactive dust and,

in some cases, also bacterial aerosols. Protection against the effect of toxic substances, poisonous smokes and many pathogenic agents is not achieved with them.

STORAGE AND MAINTENANCE OF DEVICES FOR THE PROTECTION OF THE ORGANS OF RESPIRATION

The working order of devices for protecting the organs of respiration and the preservation of their protective properties depend, to a considerable degree, on correct storage and maintenance. Hence, it is necessary to watch systematically the condition and working order of the protective devices and to maintain them constantly in full readiness for use according to their purpose. If small defects are discovered, everyone must eliminate them himself.

Devices for the protection of the organs of respiration are damaged by impact and other mechanical action, the goggles may be damaged, metallic parts crumpled, the face part torn, or the valves damaged. Excess humidity may lead to rusting of metallic parts, to a lowering of the absorbent properties of the charge in filtering gas masks as a result of their humidification, etc. Particularly dangerous is access of water to the cartridge of filter-type gas masks. High temperatures also have a harmful effect on the protective devices. Hence, they are best stored in dry places at room temperature at a sufficient distance from heating devices (preferably at a distance of not less than 3 m).

In the maintenance of isolating gas masks, special attention must be paid to protection of the regenerating cartridges and the oxygen cylinders against moisture and high temperature and also against impact. Isolating antigas masks should not be greased.

Gas masks which have been exposed to rain must be taken out of the bag at the first opportunity, carefully wiped with a cloth or something similar and dried on the air. Gas masks should be put only into a

dry bag.

All members of the family should know where the gas masks and respirators are kept.

II. DEVICES FOR PROTECTING THE SKIN

GENERAL INFORMATION

Under conditions of attach with nuclear, chemical and bacterial weapons, the entire human body must be protected in addition to the organs of respiration and eyes. Various devices for skin protection are used for this purpose. These devices are conventionally divided according to their purpose into two main groups: special standard types and improvised types. The nonmilitary formations of civic defense are equippped with the former for use during the carrying out of work in fire centers, the latter are mass means of protection for the population.

To the special standard devices for skin protection belong: the protective overall, the light protective suit L-1, the protective waterproof coat OP-1, the protective filtering garment ZFO and the protective apron. An ordinary garment impregnated with a special composition, with certain design variations to achieve an airtight fit, may serve as an improvised protective skin device.

The devices for skin protection are made from isolating (impermeable to air), or permeable material with filtering properties. The devices for skin protection made from isolating materials, depending on design, may be airtight (overall) or not airtight (apron).

Let us stop briefly to consider the properties of the isolating and filter materials, of which skin protection devices are made.

The protective materials used for making skin protection devices of the isolating type, normally consist of a woven base, and an imper-

meable film. The base serves as an underlayer for the film and guarantees the mechanical strength of the material only. The base is made of a fabric. In some cases, when the impermeable film is sufficiently strong, the base is not essential, for example in rubber gloves, the face parts of gas masks, etc. The protective properties of these materials are mainly provided by the film, for which natural and synthetic rubber, synthetic resins, etc. are used.

The protective effect of the isolating materials consists in the fact that the film retains the chemical agents falling on it for some time. The penetration of the chemical agents through the protective material is due to swelling and diffusion. The swelling is a consequence of the dissolution of the chemical agent in the film. By diffusion in this case, is meant the gradual displacement of the chemical agent from the external layers where its concentration is higher, deeper into the material, where the concentration of the chemical agent is less or zero. As a result, the chemical agent which has come into contact with the frontal side of the material, reaches the opposite side of the film after some time and begins to penetrate the backing tissue.

The time elapsed between the action of the liquid or gaseous chemical agent on the frontal side of the tissue until the appearance of chemical vapors on the inside of the fabric in a quantity sufficient for minimum injury, is termed the time of protective effect of the fabric or its protective power. Depending on whether liquid or gaseous chemical agents act on the material, the protective power of the fabric against liquid or vapors of the chemical agent are distinguished.

The time elapsed from the moment of action of liquid of the chemical agent on the frontal side of thefabric to the appearance of liquid chemical agent on the inside, characterizes the permeability of the fabric. The protective properties of different materials can be

determined by means of these basic indices.

The protective power against liquid chemical agents is typical for isolating materials of the airtight type (overall, suit) and the permeability for devices like aprons, covers, etc. The protective effect against vapors is mainly significant in connection with filter type protective devices.

The protective effect of filter materials consists in the fact that during the passage of contaminated air through the material, the molecules of the chemial agent diffuse from the airflow into the surface of the fibers and are absorbed by the impregnation of the material. Because the impregnation covers only the fibers of the fabric, while the space between the fibers remains open, the permeability of the filtering materials to air is preserved.

Substances which either dissolve the vapors of the chemical agent or interact chemically with them, are used for impregnation. Protective materials, which absorb the vapors of chemical agents by dissolution (absorption) in the impregnation, are termed absorbents. If, however, they absorb the chemical vapors in consequence of chemical interaction with the impregnation, they are termed chemisorbent materials.

Chemisorbent fabrics have several advantages, as compared with absorbent fabrics. Because the chemical agent is neutralized by the impregnation, the protective properties of the fabric are increased, the danger of evaporation of the absorbed vapors is eliminated and there is no need for decontamination of this type of protective clothing.

The positive features of absorptive fabrics are the universal action and the great stability of the protective properties during prolonged storage.

After this brief acquaintance with the general information con-

cerning skin protection devices, let us pass on to examination of the individual models.

SKIN PROTECTION DEVICES ON THE BASIS OF ISOLATING MATERIALS

The light protective suit L-1 (Fig. 18) is intended for protection against toxic and radioactive substances and bacterial agents during chemical, radiation and bacterial reconnaissance. It is made of rubberized fabric. The suit L-1 consists of a shirt with a hood, trousers with stockings, mittens and a cap. Besides, there is a carrying bag for transporting the suit and a pair of spare mittens. On the shirt there is a neck flap and an intermediate strap and on the sleeves, loops which go around the thumbs. To the trousers, are sewn shoulder straps and to the stockings straps for attaching the socks to the feet. The mittens have rubber bands for attaching them to the hands. The size of the suit is shown on the lower frontal part of the shirt, on the upper part of the trousers (on the left) and on the upper part of the mittens (L-1 is made in three sizes). The overall weight is about 3 kg. The material of the suit is strong and elastic, waterproof and frost-resistant.

The protective overall (Fig. 19) serves for protection during work under conditions of heavy contamination with chemical agents, radioactive substances and bacterial weapons (agents), and in the absence of a light protective suit, also during chemical reconnaissance. It is made of rubberized fabric and consists of trousers, jacket and hood sewn in one piece. In the upper part of the hood, there is a strap with loops and on the left side of the collar a neck strap. Lower down, in front of the collar, there is a longitudinal slit. Under the slit along the left hem, a chest flap with buckles is sewn on and towards the chest flap in its upper part, a neck flap. The sleeves end in cuffs with loops for the thumbs and cuffs with straps and the trousers in cuffs

with buckles.

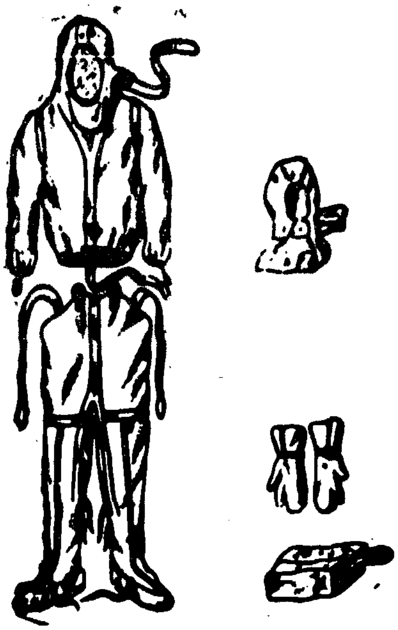

Fig. 18. Light protective suit L-1.

In addition to these overalls, suits are also used for the same purpose in which the jacket and trousers are made separately.

The protective overall and suits, like the light suit L-1, come in three sizes: the first size is for persons with a height of up to 165 cm, the second from 165-172 cm and the third for persons of over 172 cm. The size of the overall is marked on the upper edge of the chest flap.

For the protection of the hands and feet in combination with the overalls and protective suits, rubber gloves with five fingers are used (one size) and rubber boots (six sizes: No. 41-46). The weight of the overall (suit) is about 3.5 kg and together with the gloves and boots, about 5 kg.

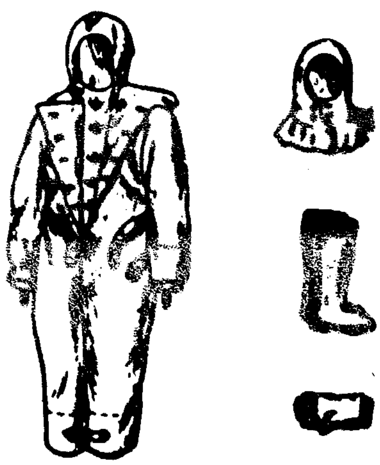

Fig. 19. Protective overall (a full set)

In recent times, the protective coat OP-1 has come into use in the nonmilitary formations of civic defense (Fig. 20), which in combination with protective socks, gloves and an impregnated (with special substances) suit can be used instead of the protective one-piece and two-piece suits. The protective coat OP-1 with sleeves and hood is made from a special fabric. It is produced in five sizes: the first for people with a height of up to 165 cm, the second from 165 to 170 cm, the third from 170 to 175 cm, the fourth from 175 to 180 cm and the fifth above 180 cm.

The coat OP-1, depending on the use to which it is put, can be used

in the form of a cloak, worn with sleeves or in the form of an overall. In the form of a cloak, the protective coat is used at the moment of chemical or bacterial attack and also when fallout of radioactive substances from the cloud formed by the nuclear explosion is present.

During activity in places contaminated with radioactive substances and bacterial agents and also when carrying out degassing, deactivation and disinfection work, the protective coat is donned with the sleeves. The flaps of the coat may be buttoned up or unbuttoned, depending on the conditions under which the work must be carried out.

In places contaminated with poison gas, the coat is used as an overall. In some cases (for example, if severe dust formation takes places), the coat is worn as an overall also in places contaminated with radioactive substances. The order of donning the coat in the form of an overall is described in the section "Rules for using protective clothing."

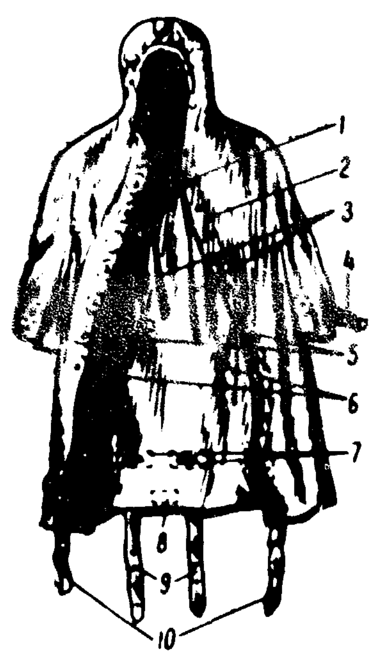

Fig. 20. Protective coat OP-1. 1) Lapel pegs; 2) lapel peg loops; 3) straps; 4) sleeve clasp; 5) loops for the central pegs; 6) fasteners; 7) claspholders; 8) central peg; 9) rear straps; 10) side straps.

Protective aprons made from rubberized fabric are normally used

during execution of work connected with decontamination and transport. The weight of the apron is about 0.4 kg. The apron protects only the chest, abdomen and thighs. The protective properties of the apron are due to the properties of the material of which it is made.

To protect the feet, in addition to rubber boots, protective socks are also used, made from rubberized fabric. Their soles are reinforced with canvas or reinforced rubber. The socks with canvas soles have two or three straps for attaching to the foot and one strap for attachment to the belt. Socks with rubber soles are attached to the feet by means of straps and to the belt by means of a ribbon. The protective socks are made in three sizes: the first for boots No. 37-40, the second for boots No. 41 and 42, and the third for boots No. 43 and over.

PROTECTIVE FILTERING SUIT

One of the principal defects of airtight suits from isolating materials is the disturbance they cause in the heat exchange of the organism and the corresponding limitation of the time of work possible in them. In contrast to the airtight isolating suit, the filtering suit practically does not interfere with the thermal regulation of the human organism.

The filter-type protective suit is a suit of usual or special style made of cotton or other fabrics, impregnated with chemicals, which retains chemical agents (absorbent type), or neutralize them (chemisorbent type).

The formations of civic defense are equipped with the protecting filtering suit ZFO-58, which consists of a cotton overall of special style, impregnated with special chemicals, men's underwear (shirt and drawers), a cotton cap comforter and two pairs of cotton leggings, one of which is impregnated with the same composition as the suit.

The main purpose of the protective filtering suit is the protection

Fig. 21. Overall ZFO-58.

of the skin against toxic agents in the form of vapors. In the impregnated form, as well as without impregnation, the ZFO-58 also provides protection against bacterial agents, used in the form of aerosols and radioactive dust.

The underwear, comforter and nonimpregnated leggings are used in order to prevent friction and irritation of the skin.

The overall ZFO-58 (Fig. 21) consists of trousers, jacket and hood. On the front of the overall, there is a longitudinal slit, which can be buttoned up. Under the slit, along the hems, an internal blind chest flap, ending in a neck flap with a stand-up collar, which is closed behind with a rubber band on a button, thus tightly fitting around the neck, is sewn on. To the sleeves of the overall are sewn cuffs with straps for the thumbs and external cuffs at the end of which rubber bands are sewn on. The trousers are fitted with straps and a rubber band on the lower end. The overall is equipped with a belt. The overalls are made in three sizes: the first for persons with a height of up to 160 cm, the second from 160 to 170 cm and the third for 170 cm and over. The size is shown on the outside on the center of the chest flap.

The comforter is a cotton hood, having a round slit for the face and a continuous (not slitted) cape. The comforters come in three dimensions: the first for head sizes No. 53-55, the second for No. 56-58 and the third for No. 59-62. The size is indicated on the inside of the comforter.

Impregnation for the protective filtering suit

Aqueous solutions of special pastes are used for impregnating the

filtering protective suits. Three liters of solution are required for one protective suit combination.

Impregnation can be carried out in a closed room as well as in the open at a temperature not under +3°C in the following order. The paste is first carefully mixed in the container in which it has been kept, then the required quantity is measured out and poured into a bucket or other container, adding water (one part of water, preferably hot, to two volumes of paste) and again carefully stirred for 2-3 minutes until a uniform solution is obtained. The suit and the foot cloths are placed into a trough (basin, etc.) and uniformly moistened with the ready solution. As soon as the solution has been completely absorbed, the foot cloths and the overall are wrung out, the overall is turned inside out and again moistened with the residual solution. The impregnated overall is then placed on a sheet of plywood (on the table or floor) and rubbed with the impregnated foot cloths in order to distribute the solution more uniformly along the entire surface of the fabric.

The impregnated items of the protective filtering suit are then dried in the open air, in a closed room or in a drying apparatus at a temperature not over 70°C. It is not permitted to press the dried impregnated protective suit with a hot iron. All work connected with impregnation of the ZPO should be carried out with rubber gloves.

RULES OF UTILIZATION OF PROTECTIVE CLOTHING

The sequence of donning and taking off of the light protective suit L-1 and the protective overall (suit) has been sufficiently broadly described in the various textbooks and brochures. Hence, when discussing the rules for using protective clothes on the basis of isolaing materials, we shall dwell in greater detail only on the sequence of donning and taking off of the protective coat OP-1 (Fig. 22).

For putting on the protective coat in the form of an overall, the

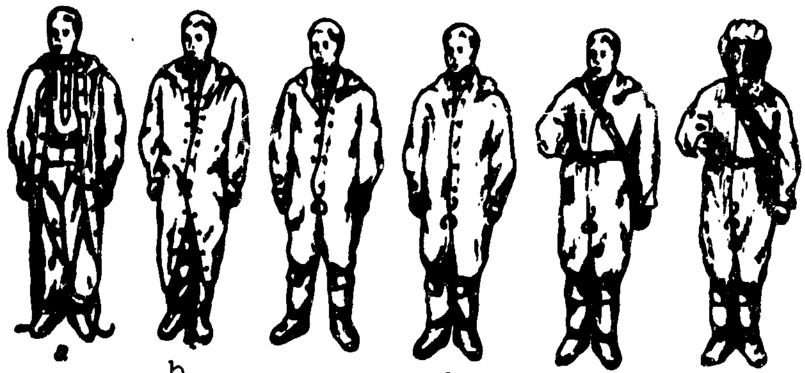

Fig. 22. Method of putting on the protective coat, when it is to be used in the form of an overall.

following must be observed:

1) the headgear must be taken off;

2) the stockings are put on, then the coat with the sleeves and the sleeve straps are fastened;

3) the ends of the rear and side straps of the coat are undone and taken out of their holders;

4) the rear straps of the coat are drawn forward between the legs and attached to the belt (trouser belt) on the left and right side (Fig. 22,a);

5) the central holders of the pegs are attached to the middle peg first on the right and then on the left flap of the coat and fastened with the clip on the laft flap (Fig. 22,b);

6) the flaps of the coat are attached to the pegs in such a manner that the left flap encloses the left leg and the right one, the right leg; the holders of the two pegs directly under the central peg are fastened with their clips;

7) the lateral straps of the coat are attached to the pegs by first wrapping them around the leg under the knees; the free ends of the straps are fastened one or two turns on the pegs (Fig. 22,c);

8) the lapel of the coat is buttoned up, leaving the two upper

holders unbuttoned (Fig. 22,d);

9) the gas mask is put on over the coat (Fig. 22,e);

10) the gas mask is brought into the "combat" position;

11) the hood is put on the head and the remaining holders of the coat and the clasp of the hood are buttoned;

12) the straps of the sleeves are fastened, the gloves put on under the cuff of the sleeves, the straps of the sleeves fastened up and their free ends laced with one or two turns on the pegs (Fig. 22,f).

In order to take off the protective coat, it is necessary to:

1) take off the gas mask bag and take out the antigas cartridge from the bag, letting it hang freely on the connecting hose;

2) undo the two upper holders and the strap of the hood;

3) undo the side straps;

4) undo the clips, undo the flaps and the lapel of the coat and the lower and middle straps of the protective socks;

5) pull the hood backwards;

6) undo the straps of the sleeves and take off the gloves;

7) pull out the arms from the sleeves, take off the coat from the shoulders and throw it back with the outer side downwards;

8) undo the rear straps of the coat from the belt;

9) take off the protective socks;

10) step on the windward side and take off the gas mask.

The filtering suit is put on in the following order: first the underwear (in such a manner that the shirt is tucked into the drawers, while the straps on the leg parts of the drawers are tied on top of the unimpregnated leggings, then the suit; its chest flap is arranged and the three lower buttons of the slit of the suit are buttoned up. Then, the impregnated leggings are tied around the legs, which are fastened to the leg parts of the trousers and the footstraps of the leg parts

are led around the soles of the feet and the rubber boots are put on.

The comforter is first put on the connecting hose of the gas mask, for which purpose the face part is passed through the outer side of the comforter through its frontal slit. The face part, together with the comforter put on in this manner, is put into the bag.

The belt of the overall is buttoned above the rear strap of the gas mask bag and the protective gloves are put on in front of the belt. After bringing the gas mask into the "combat" position, the comforter is put on the head, the chest flap of the suit arranged and the collar of the neck flap is tucked in on top of the comforter and fastened on the back with a rubber band on the button.

After the hood has been put on the head, the chest of the suit is buttoned up on all buttons. In order to make the frontal slit of the hood lie tightly against the mask, the strings are tied, then the neck strap is fastened.

The straps of the sleeve cuffs are put on the thumbs, the outer cuff of the sleeves of the suit are raised and the gloves put on and the cuffs are then put over them.

The protective filter suit is taken off, as a rule, at the bathing station not later than an hour after leaving the focus of chemical contamination in the following order. The gloves are taken off, the strap undone and the neck strap of the overall undone, the buttons of the chest slit and of the belt of the suit are undone. Then, the gas mask bag is taken off and the cartridge taken out of it. Removing the hood and undoing the rubber band of the neck flap of the suit, the suit is first taken off the shoulders and then completely, together with the boots and the impregnated leggings. The hands are decontaminated and the gas mask (without taking it off) with a solution from the individual antigas packet. Proceeding to the point, where the under-

wear is taken off, the unimpregnated leggings, the drawers and shirt with comforter are taken off. The gas mask is taken off last.

After undressing, the mucosa of the nose and eyes must be treated and washed under the shower with hot water and soap.

ORDER OF USAGE OF THE PROTECTIVE SUIT AT DIFFERENT TEMPERATURES

In order to preserve maximum working capacity when using the protective isolating suit, under conditions of different temperature of the ambient air, the protective suit is put on:

a) at a temperature of +15°C and over, as a rule, over the underwear;

b) at a temperature of 0 to +15°C, above the summer outfit;

c) at a temperature of 0 to -10°C, above the winter outfit;

d) at a temperature below -10°C, over the quilted jacket.

The light protective suits are, in all cases, put on over the suit.

In order to prevent overheating of the body, the following maximum periods of continuous work in the protective suit of the isolating type (including the protective coat, when used as an overall and also when put on with the sleeves and buttoned up) have been stipulated:

Temperature, °C	Time, minutes
30 and over	15-20
25-29	up to 30
20-24	40-45
15-19	90-120
under +15	over 180

When working in the shade, also in overcast or windy weather, the time of continuous stay in the protective suit can be increased by 50% if the necessary training has been carried out.

In order to facilitate work in the protective isolating suit and

also for prolonging the time of continuous stay in it, . wet shielding (cooling) overall, which is put on at a temperature of +15°C and over.

The wet shielding overall (Fig. 23) is a cotton suit which either before putting on, or after it has been put on over the protective suit is wetted with water. It is also an additional means of protection against liquid and gaseous chemical agents, radioactive dust and bacterial agents.

Fig. 23. Wet shielding overall.

In front of the overall, there is a longitudinal slit which is covered by a chest flap, sewn on one side to the left hem of the suit. On the outer side, the longitudinal slit is fastened with five buttons. A hood is sewn onto the collar of the overall. To the left frontal lug of the hood, a neck flap in the form of a tie, which is wound around the hood and is fastened to a button at the base of this tie, is sewn. On the overall, on the left frontal side, there is a special pocket for the antigas cartridge. Above this pocket, there is a flap for attachment to the connecting hose of the gas mask. At the end of the sleeves of the suit, straps are sewn on for tying them and lower down on the trousers, there are straps which are fastened around the boots. The shielding overall is made in three sizes, calculated for being put on over the isolating suit of the corresponding size.

Depending on the temperature of the ambient air, the solar radiation and wind, the wet shielding suit should be wetted again with water after a certain interval of time during working:

a) at an air temperature of 20 to 25°C, after 2-2.5 hours of work;

b) at an air temperature of +25°C and over, after 1-1.5 hours of work.

The overall must be moistened again whenever dry spots appear on it. If the overall is periodically moistened, the time of continuous stay in the suit may be increased to 6-8 hours.

The wet shielding overall is put on in the "alarm" position in the following sequence. First, the trousers are put on, then the overall over the sleeves and shoulders of the isolating suit. Having arranged the chest flap, the hem of the overall is fastened on the four lower buttons. After this, the straps on the trousers are fastened around the boots and belt. The antigas cartridge is put into the special pocket and the connecting hose attached to the flap. The gloves and comforter are fastened in front of the belt, with the right glove on the right and the left one on the left and the comforter in the middle. The wet shielding overall is brought into the "combat" position simultaneously with the protective isolating suit. After putting on the gas mask, the impregnated comforter and the hood of the isolating suit, the hood of the wet shielding overall is put on. The overall is fastened to all the buttons, the neck flap (tie) is tied around the hood and also fastened to the button. The gloves are put on and covered with the oversleeves of the suit, around which the straps are fastened.

The wet shielding overall is taken off as a rule, separately from the insulating protective suit in the following order. First, the knots on the sleeves are undone and the buttons on the straps of the trousers are opened, then, the buttons of the neck flap and the hems of the chest flap are opened and on the flaps of the pockets for the antigas cartridge and the connection hose. The cartridge is taken out and is left swinging freely on the connecting hose. Pulling on the sleeves in turn, the overall is taken off the shoulders; the trousers are let down

and the wet shielding overall is completely taken off from the protective isolating suit.

The shielding overall can be used, if necessary, as an isolating suit in combination with the gas mask, boots and gloves, as a protection for the skin only against radioactive dust and bacterial agents.

In absence of a shielding overall for cooling, a suit of a dense cotton fabric of any style may be used: jacket with trousers, ski dresses, etc. In any case, the fabric must lie closely against the protective isolating suit. The hood of the isolating suit should also be covered with a wet fabric.

RULES FOR STORAGE OF SKIN PROTECTION EQUIPMENT

The equipment for skin protection should be stored in dry stone, or wooden storerooms at room temperature removed from doors and ventilating devices.

The windows of the storeroom should be whitewashed or fitted with curtains. Skin protection devices should not be stored together with gas decontamination compounds, acids, alkalis, fuels and easily inflammable materials. It is not recommended to store protective devices of rubberized fabric in the hung-up position, or to put them on shelves.

The protective filtering suit can be stored in the impregnated, as well as in the unimpregnated form in ordinary storehouses, together with other protective devices. The impregnated and unimpregnated parts of the ZFO combination should be kept separately, folded into bundles. Under all storage conditions, the impregnated protective filtering suit should be protected against direct sunlight, water and dust. On the shelves and in stacks, the impregnated suit is placed with a slight clearance between the bundles, in order to promote natural circulation of air.

The paste for impregnation of the filter suit is stored in ordinary

warehouses at a temperature of not less than +1°C and not over +30°C in an airtight glass or metal container.

IMPROVISED SKIN PROTECTION DEVICES

In the absence of standard skin protection devices, improvised aids are used. The improvised aids for skin protection are intended to protect the skin of humans against radioactive dust and bacterial agents and, if specially impregnated, also against poison gas.

The simplified (improvised) protective combination (Fig. 24) may consist of a ski or ordinary suit or standard quilt suit (jacket and trousers), gloves (rubber, leather or impregnated woolen or cotton gloves), rubber boots of industrial and civilian type or rubber overshoes (galoshes) with impregnated socks or felt boots with galoshes.

Improvised means of skin protection are used in combination with the civilian gas mask and in absence of poison gas, with a respirator or antidust fabric mask.

Clothes with additional design adaptations, but without impregnation are used only for protection against radioactive and bacterial aerosols.

Rubberized and canvas coats, cloaks and coats made of plastic film and other improvised means, can be used for protection against drops of chemical agents and also for additional protection against radioactive and bacterial aerosols, in combination with the impregnated protective suit.

Additional airtightness and impregnation of the suit is provided by the population itself under domestic conditions, or in an organized manner in the house managements, industrial enterprises, institutes, educational establishments, collective farms, etc.

Preparation of airtight accessories

To improve the protective properties of normal clothing, they are

Fig. 24. Simplified protective combination.

made more airtight by means of simple accessories. The points where clothes are not airtight, are the chest slit, collar, the lower end of the jacket, the connection between sleeves and gloves and between the lower part of the trousers and the footwear.

The airtightness at the chest slit of the coat (jacket, overall) is achieved by using a chest flap (lapel) made from any tightly woven fabric in the shape of a rectange, with a length of 80 cm and a width of 25 cm with turned-back corners at the upper end of the lapel.

For protection of the neck and the bare parts of the head and also for producing an airtight fit at the collar of the protective suit, a simplified hood must be used, which can be made from dense cotton or woolen cloth. Instead of the simplified hood, normal kerchiefs may be used (pieces of fabric, hoods, etc.).

The lateral slits of sporting and some other forms of trousers used in protective clothes combinations, must be made airtight by sewing on triangular pieces under the slits. The airtight fit of the suit between jacket and trousers, sleeves and gloves, the lower end of the trousers and the boots is achieved by corresponding corrections.

The protective three-digit gloves of cotton fabric are made with a single pattern, without divisions into left and right ones. They can have a long collar which, when putting on the gloves, reaches to the elbow joint. In this case, the collar (from the wrist to the elbow), is sewn from a single piece of fabric and the lower part of the glove (hand) from two layers of fabric. Such gloves have two sewn-on tightening

laces; one at the end of the collar, the other on the wrist. The purpose of these laces is to prevent slipping of the gloves and thus ensuring their convenience and reliability during work. Gloves with a short collar are entirely made of two layers of fabric. On the upper side of the collar, there is also a tightening lace sewn on.

The protective socks of cotton fabric are similar in design to the models of the warm quilt socks used by civilians. A special feature of the protective socks is that their soles and lower part .. made from two layers of fabric and the top part (from the soles to the middle of the top length) are made from two layers of fabric, while the top part is made from one layer of fabric. To reinforce the soles of the socks, they are stitched (quilted) and to the heel part, a leather backing is sewn. Two pairs of straps are sewn to the socks: an upper one for fastening the sock to the leg under the knee and a lower one for attachment of the galoshes to the foot.

Impregnation with improvised skin protection materials

Improvised skin protection aids,with the aim of imparting antigas protection properties to them, are either soaked in a solution made from synthetic wetting agents (OP-7 or OP-10) used for laundering underwear, or a soap-oil emulsion on the basis of mineral (gear, transformer, machine oil,etc.) or vegetable (sunflower, cottonseed,etc.) oils. Approximately 2.5 liters of solution are required for impregnating one improvised combination.

The solution on the basis of OP-7 (OP-10) is made in the following manner: 0.5 ℓ of OP-7 (OP-10) are mixed 2-3 minutes with 2 ℓ of water and warmed to 40-50°C, until a uniform solution of light-yellow color is obtained.

To prepare the soap-oil emulsion, 250-300 g of finely ground household soap (soap flakes) are dissolved in 2 ℓ of water, heated to 60-70°C

and after dissolution of the soap, 0.5 ℓ of oil are poured into the hot solution. The mixture is stirred for 5 minutes and again heated under constant stirring until a uniform soap-oil emulsion is obtained.

The following parts of the protective combination are impregnated: men's (sporting, working, school, etc.) suits, coats (kerchiefs, etc.), socks, leggings, knitted gloves (from cotton fabric) and singlets. They must be checked for faults prior to impregnation.

The hot solution prepared for impregnation is poured on the suit, placed in a basin (trough, etc.) and uniformly distributed over the suit with the hands. The suit is then pressed out, turned inside out and again impregnated. Care must be taken to ensure that unimpregnated (dry) spots are not left. The suit is finally wrung out and dried in the open air. The remaining parts of the combination are impregnated with the remaining solution, observing the same rules.

Suits impregnated with synthetic moistening agents or soap-oil emulsions do not have any odor, they do not irritate the skin and are easy to wash. Impregnation does not destroy the suit and facilitates its decontamination from poison gas and radioactive dust.

The improvised protective combination is put on over the underwear or a summer suit. The singlet and jacket are tucked into the trousers. The lower edge of the trousers and of the coat sleeves are tied with straps. The impregnated socks are put on over normal socks and then the boots. If an attack threatens, the gas mask is put on, the collar of the jacket turned up and the coat and gloves put on.

Decontamination of improvised skin protection aids

The decontamination of clothes is carried out at the first opportunity after leaving the contaminated area.

Improvised skin protection devices are chemically decontaminated by one of the following methods:

a) the suit, impregnated with OP-7 (OP-10) is soaked in water at 50-60°C for 30 minutes;

b) a suit which has been impregnated with an aqueous oil emulsion is soaked in water at 50-60°C for 1 hour;

c) quilted clothes and coarse woolen clothes are soaked in a 2% aqueous solution of soda (ash) or in a 1% solution of lime at 20°C for 1,1/2 hours.

Rubber boots (boots, galoshes) and gloves are degassed by boiling in a 1-2% aqueous solution of soda or slaked lime for 1 hour.

In individual cases of contamination with vapors of "zarine" type decontamination of the clothes can be carried out directly on the person wearing them without taking them off, by rubbing with a soap-soda solution. For preparing such a solution, 250 g of calcinated soda and 25 g of household soap are dissolved in 10 ℓ of water. The rubbing is done with a rag or paper, soaked in the solution. For treating one combination of overclothes and footwear approximately 0.8-1.0 ℓ of solution is required.

In the absence of decontamination solutions, the decontamination of unimpregnated clothes contaminated with chemical agents, can be carried out with the aid of heat treatment, based on the desorption of the chemical agents from the contaminated articles. To this end, immediately after leaving the contaminated zone, fires are lighted and standing around them and gradually turning, the clothes are heated. The upper garments (overcoat, sheepskin coats,etc.) are taken and warmed at the fire from the inside. The total duration of treatment at the open fire is 40-45 minutes. It is categorically forbidden to take off the gas mask during decontamination by these methods.

Deactivation of improvised means of skin protection is carried out by all the known methods: shaking out, beating, cleaning with a

vacuum cleaner, washing manually or in washing machines. Vacuum cleaners, brushes or besom, the clothes and footwear should not be taken off. The gas mask or respirator must be left on during this procedure.

Disinfection of clothes is carried out by boiling in water for 1 hour. Clothes can also be disinfected by soaking in disinfectant solutions: when contaminated with nonsporeforming microbes, in 5% aqueous solution of phenol or lysol, 3% solution of monochloramine or in 2.5% solution of formaldehyde for 1 hour; when contaminated with sporeforming microbes, in a 10% formaldehyde solution for 2 hours. The proportion by weight of disinfectant solution and clothes should be 5:1.

Leather and rubber footwear is disinfected by careful rubbing or washing with 5% aqueous solution of phenol, lysol, naphtalysol or 3% solution of monochloramine. After treatment, the leather footwear is washed with water and oiled.

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